

Claims

We claim:

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1. An ion generator comprising:

a first electrode;

a second electrode;

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a voltage generator electrically coupled to the first electrode and the second electrode in order, when energized, to create a flow of air in a downstream direction from the first electrode to the second electrode;

a trailing electrode located downstream of the second electrode.

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2. The generator of claim 1 wherein said trailing electrode and said second electrode are electrically connected.

3. The generator of claim 1 wherein said trailing electrode and said second electrode have the same sign potential when said voltage generator is energized.

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4. The generator of claim 1 that can charge and remove particles from air, wherein said second electrode is a collector electrode that can collect charged particles and said trailing electrode can collect charged particles.

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5. The generator of claim 1 wherein said first electrode emits ions when said voltage generator is energized, and wherein said trailing electrode can neutralize the ions emitted by said first electrode.

6. The generator of claim 1 wherein said first electrode emits positive ions when said voltage generator is energized, and wherein said trailing electrode can neutralize the positive ions emitted by said first electrode by emitting negative ions.

5 7. The generator of claim 1 wherein said trailing electrode is pointed.

8. The generator of claim 1 wherein said trailing electrode is triangle is shape.

10 9. The generator of claim 1 wherein said second electrode is removable by a user.

10. The generator of claim 1 wherein said second electrode is removable by a user for cleaning.

15 11. The generator of claim 1 wherein said generator is incorporated in a housing and with said housing comprises an electro-kinetic air transporter-conditioner.

12. The generator of claim 1 wherein said second electrode is elongated and said trailing electrode is elongated to about the same length as the second electrode.

20 13. The generator of claim 1 wherein said generator is incorporated in an elongated freestanding housing and with said housing comprises an electro-kinetic air transporter-conditioner.

25 14. The generator of claim 1 wherein said generator is incorporated in a housing and with said housing comprises an electro-kinetic air transporter-conditioner and said housing has a top and said second electrode is removable from said top for cleaning.

15. The generator of claim 1 wherein:

said generator is incorporated in an elongated freestanding housing with a top and with said housing comprises an electro-kinetic air transporter-conditioner; and

wherein said second electrode is elongated and is removable from said top of said housing.

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16. The generator of claim 1 wherein:

said generator is incorporated in an elongated freestanding housing with a top and with said housing comprises an electro-kinetic air transporter-conditioner; and

wherein said second electrode is elongated and is at least partially removable from said top of said housing.

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17. The generator of claim 1 wherein:

said generator is incorporated in an elongated freestanding housing with a top and with said housing comprises an electro-kinetic air transporter-conditioner; and

wherein said second electrode is elongated and is telescopingly removable through said top of said housing.

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18. The generator of claim1 wherein:

said second electrode is an elongated fin and said trailing electrode includes an elongated cylindrical column which is located downstream of one of said second electrode.

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19. The generator of claim1 wherein:

said second electrode is an elongated fin and said trailing electrode includes an elongated cylindrical column which is located directly downstream of said second electrode.

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20. The generator of claim1 wherein:

said second electrode includes two elongated fins and said trailing electrode includes an elongated cylindrical column which is located directly downstream of one of said two elongated fins so as to minimize any restriction to the flow of air past said second electrode.

5      21.      The generator of claim 1 wherein:

said second electrode has a width along a direction across the downstream direction and said trailing electrode includes a width that is about the same as or less than the width of the second electrode.

10      22.      The generator of claim 1 wherein:

said trailing electrode is directly downstream of said second electrode.

23.      The generator of claim 1 wherein:

15      said second electrode is a fin that extends in the downstream direction and said trailing electrode is located directly downstream of said second electrode.

24.      The generator of claim 1 wherein said trailing electrode and said second electrode have the same sign potential when said voltage generator is energized in order to cause charged particles contained in a flow of air downstream from the first electrode to the second electrode to be urged  
20      toward the second electrode.

25      25.      The generator of claim 1 wherein said second electrode includes two electrodes and said trailing electrode is wire-shaped or rod-shaped and is located substantially midway between the two electrodes.

26.      The generator of claim 1 wherein said second electrode has a width across the downstream

direction and said trailing electrode is located a distance of at least three times the width of the second electrode downstream of the second electrode.

27. The generator of claim 1 including a plurality of trailing electrodes.

28. The generator of claim 1 wherein said first electrode is an ion emitter and the second electrode is a collector of particulate matter.

29. The generator of claim 1 wherein said first electrode is positively charged and the second electrode is negatively charged.

30. The generator of claim 22 wherein said first electrode is pin-shaped.

31. An ion generator comprising:

a first electrode;

a second electrode;

a voltage generator electrically coupled to the first electrode and the second electrode in order, when energized, to create a flow of air in a downstream direction from the first electrode to the second electrode;

third means located downstream of the second electrode for at least one of (1) causing charged particles to deflect toward the second electrode, (2) emitting ions that are of a different potential sign as the first electrode, and (3) collecting charged particles.

32. The generator of claim 31 wherein said third means and said second electrode are electrically connected.

33. The generator of claim 31 wherein said first electrode emits ions when said voltage generator is energized, and wherein said third means can neutralize the ions emitted by said first electrode.

5 34. The generator of claim 31 wherein said first electrode emits positive ions when said voltage generator is energized, and wherein said third means can neutralize the positive ions emitted by said first electrode by emitting negative ions.

10 35. The generator of claim 31 wherein said third means is pointed.

36. The generator of claim 31 wherein said third means is triangle in shape.

37. The generator of claim 31 wherein said second electrode is removable by a user.

15 38. The generator of claim 31 wherein said second electrode is removable by a user for cleaning.

39. The generator of claim 31 wherein said generator is incorporated in a housing and with said housing comprises an electro-kinetic air transporter-conditioner.

20 40. The generator of claim 31 wherein said second electrode is elongated and said third means includes a trailing electrode that is elongated to about the same length as the second electrode.

25 41. The generator of claim 31 wherein said generator is incorporated in an elongated freestanding housing and with said housing comprises an electro-kinetic air transporter-conditioner.

42. The generator of claim 31 wherein said generator is incorporated in a housing and with said housing comprises an electro-kinetic air transporter-conditioner and said housing has a top and said second electrode is removable from said top for cleaning.

5 43. The generator of claim 31 wherein:  
said generator is incorporated in an elongated freestanding housing with a top and with said housing comprises an electro-kinetic air transporter-conditioner; and  
wherein said second electrode is elongated and is removable from said top of said housing.

10 44. The generator of claim 31 wherein:  
said generator is incorporated in an elongated freestanding housing with a top and with said housing comprises an electro-kinetic air transporter-conditioner; and  
wherein said second electrode is elongated and is at least partially removable from said top of said housing.

15 45. The generator of claim 31 wherein:  
said generator is incorporated in an elongated freestanding housing with a top and with said housing comprises an electro-kinetic air transporter-conditioner; and  
wherein said second electrode is elongated and is telescopingly removable through said top  
20 of said housing.

46. The generator of claim 31 wherein:  
said second electrode is an elongated fins and said third means includes an elongated cylindrical column which is located downstream of one of said second electrode.

25 47. The generator of claim 31 wherein:

said second electrode is an elongated fin and said third means includes an elongated cylindrical column which is located directly downstream of said second electrode.

48. The generator of claim 31 wherein:

5       said second electrode includes two elongated fins and said third means includes an elongated cylindrical column which is located directly downstream of one of said two second electrode so as to minimize any restriction to the flow of air past said second electrode.

49. The generator of claim 31 wherein:

10       said second electrode has a width along a direction across the downstream direction and said trailing electrode includes a width that is about the same as or less than the width of the second electrode.

50. The generator of claim 49 wherein:

15       said third means is directly downstream of said second electrode.

51. The generator of claim 31 wherein:

20       said second electrode is a fin that extends in the downstream direction and said third means is located directly downstream of said second electrode.

52. The generator of claim 31 wherein said third means and said second electrode have the same sign potential when said voltage generator is energized in order to cause charged particles contained in a flow of air downstream from the first electrode to the second electrode to be urged toward the second electrode.

25       53. The generator of claim 31 wherein said second electrode includes two electrodes and said



third means is wire-shaped or rod-shaped and is located substantially midway between the two electrodes.

54. The generator of claim 31 wherein said second electrode has a width across the downstream direction and said third means is located a distance of at least three times the width of the second electrode downstream of the second electrode.

55. The generator of claim 31 wherein said first electrode is an ion emitter and the second electrode is a collector of particulate matter.

56. The generator of claim 31 wherein said first electrode is positively charged and the second electrode is negatively charged.

57. The generator of claim 31 wherein said first electrode is pin-shaped.

58. A device for conditioning air including  
a housing with an air inlet and an air outlet  
a first electrode;  
a second electrode;  
said first electrode located closer to said air inlet than said second electrode;  
said second electrode located closer to said air outlet than said first electrode;  
a potential generator electrically coupled to the first electrode and the second electrode in order, when energized, to create a flow of air in a downstream direction from the first electrode to the second electrode; and  
a trailing electrode located downstream of the second electrode.

59. A device for conditioning air including  
a housing with an air inlet and an air outlet  
a first electrode;  
a second electrode;  
5 said first electrode located closer to said air inlet than said second electrode;  
said second electrode located closer to said air outlet than said first electrode;  
a potential generator electrically coupled to the first electrode and the second electrode in  
order, when energized, to create a flow of air in a downstream direction from the first electrode  
to the second electrode; and

10 third means located downstream of the second electrode for at least one of (1) causing  
charged particles to deflect toward the second electrode, (2) emitting ions that are of a different  
potential sign as the first electrode, and (3) collecting charged particles.

60. A method for conditioning air comprising the steps of:

15 generating an electrical potential between a first electrode and a second electrode in order  
to create a flow of air in a downstream direction from the first electrode to the second electrode  
and to ionize particulate matter in the air flow; and

20 downstream of said second electrode having at least one of the following steps of (1)  
causing charged particles to deflect toward the second electrode, (2) emitting ions that are of a  
different potential sign as the first electrode, and (3) collecting charged particles.

61. An electro-kinetic air transporter-conditioner having an ion generator disposed with said  
housing having an inlet and an outlet, that creates an airflow in a downstream direction from the inlet  
to the outlet, the ion generator comprising:

25 a first electrode;  
a second electrode downstream of the first electrode;

a trailing electrode downstream of the first electrode; and

a voltage generator electrically coupled with the first and second electrode.

62. The generator as recited in claim 61, wherein the first electrode has at least one electrode  
5 that has at least one characteristic from a group consisting of (i) a rod-shaped wire, (ii) a spiral coil  
wire, (iii) a curved wire, (iv) a flat spiral wire, (v) slack wire and (vi) a tapered pin-shaped  
electrode.

63. The generator as recited in claim 61, wherein the second electrode has at least two  
10 electrodes having at least one characteristic from a group consisting of (i) a U-shaped cross-  
section, (ii) an L-shaped cross-section, and (iii) a ring-shaped.

64. The generator as recited in claim 61, wherein the trailing electrode is in-line with the second  
electrode.

65. The generator as recited in claim 63, wherein the second electrode has a U-shaped cross-  
15 section and a protective end forward with said second electrode.

66. The generator as recited in claim 63, wherein the trailing electrode and the second  
20 electrode are electrically connected.

67. The ion generator as recited in claim 61, wherein the voltage generator is further electrically  
connected to the trailing electrode.

68. An electro-kinetic air transporter-conditioner having an ion generator disposed within the  
25 housing having an inlet and an outlet, that creates an airflow in a downstream direction from the inlet

to the outlet, the ion generator comprising:

a first electrode;

a second electrode having a protective end, located downstream of said first electrode;

5 a trailing electrode located downstream to said second electrode; and

a voltage generator electrically coupled with said first electrode and said second electrode.

69. An electro-kinetic air transporter-conditioner having an ion generator disposed within a housing having an inlet and an outlet, that creates an airflow in a downstream direction from the inlet to the outlet, the ion generator comprising:

a first array of electrodes, including at least two electrodes;

a second array of electrodes located downstream of said first array, including at least three electrodes, each said electrode having a protective end;

15 a trailing electrode located downstream of each said electrode in said second array;

and

a voltage generator electrically coupled with the first and second array.

70. An electro-kinetic air transporter-conditioner, comprising:

20 a housing having an inlet and outlet; and

an ion generator disposed within the housing, that creates an airflow in a downstream direction from said inlet to said outlet, including:

a first array of electrodes;

a second array of electrodes located downstream of said first array of electrodes;

25 an array of trailing electrodes located downstream to said second array of electrodes; and

a voltage generator electrically coupled with said first and second array of electrodes.

71. An electro-kinetic air transporter-conditioner for removing particles from the air,  
5 comprising:

a housing having an inlet and an outlet; and

an ion generator disposed within said housing, that creates an airflow in a downstream direction from said inlet to said outlet, including:

a first electrode;

10 a second electrode located downstream of said first electrode;

a voltage generator electrically coupled with said first and second electrode; and

means for urging the particles towards the second electrode, located downstream of the second electrode.

72. An electro-kinetic air transporter-conditioner having an ion generator, the ion generator  
15 comprising:

a first array of electrodes;

a second array of electrodes including at least two electrodes, located downstream of said first array of electrodes, each said electrode having a nose, and two trailing sides extending  
20 downstream from said nose, and a protective end;

an array of trailing electrodes located downstream of said second array of electrodes;

and

a voltage generator electrically coupled with said first and second array of electrodes, and said trailing electrodes.

25 73. An electro-kinetic air conditioner-transporter for removing particles within the air,

comprising:

a housing having an inlet and an outlet; and

an ion generator disposed within said housing, that creates an airflow containing particles in a downstream direction from said inlet to said outlet, including:

5 a high voltage generator;

a first array of ion emitting electrodes, electrically connected to said high voltage generator, for electrically charging the particles within the airflow when said high voltage generator is energized;

10 a second array of ion collecting electrodes, electrically connected to said high voltage generator, located downstream of said first array of electrodes, for generating an electrical field with an opposite polarity to said first array of electrodes when said high voltage generator is energized, so that the charged particles are attracted to said second array of electrodes;

15 an array of trailing electrodes, electrically connected to said high voltage generator, located downstream of said second array of electrodes, and having the same polarity as said second array of electrodes when said high voltage generator is energized.

74. A device for conditioning air, comprising:

a housing having an inlet and an outlet; and

20 an ion generator disposed with said housing, that creates an airflow containing particles in a downstream direction from said inlet to said outlet, including:

a first electrode;

a second electrode, having a nose and two trailing sides extending in a downstream direction away from said nose, said trailing sides are a distance apart substantially equal to the width of said nose;

25 a trailing electrode located downstream from said second electrode, having a diameter no greater than the distance between said trailing sides of said second electrode;

a high voltage generator electrically connected to said first electrode, said second electrode.

75. A device as recited in claim 74, wherein said high voltage generator is further electrically connected to said trailing electrode.

76. A device as recited in claim 74, wherein said first electrode and said second electrode have an opposite polarity when said high voltage generator is energized.

77. A device as recited in claim 75, wherein said trailing electrode and said second electrode have the same polarity when said high voltage generator is energized.

78. A device as recited in claim 76, wherein said first electrode emits ions to electrically charge the particles contained with the airflow, and said second electrode collects the electrically charged particles.

79. A device as recited in claim 74, wherein said trailing electrode is wire-shaped or rod-shaped.

80. A device as recited in claim 75, wherein said trailing electrode emits ions of an opposite polarity to said first electrode, for neutralizing the ions emitted from said first electrode.

81. A device as recited in claim 74, wherein said trailing electrode is in-line and symmetrically aligned with said second electrode.

82. A device as recited in claim 74, wherein said trailing electrode is located downstream from

said second electrode a distance substantially equal to three times the radius of said nose.

83. The ion generator of claim 1 wherein said second electrode is elongated and has a base, and said trailing electrode is located at the base of the elongated second electrode.

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84. The ion generator of claim 1 wherein said second electrode is elongated and said trailing electrode has a pointed shape.

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85. The ion generator of claim 1 wherein said second electrode is elongated and fin-shaped and has a base, and said trailing electrode has a pointed shape and is located at the base of the second electrode.

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86. The ion generator of claim 1 wherein said first and second electrodes are elongated and said trailing electrode is substantially shorter than the first and the second electrodes.

87. The ion generator of claim 1 wherein said second electrode is elongated and said trailing electrode is triangle-shaped.

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88. The ion generator of claim 1 wherein said second electrode is elongated and has a base and said trailing electrode is triangle-shaped and located at the base of the second electrode.

89. The ion generator of claim 31 wherein said second electrode is elongated and said third means has a pointed shape.

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90. The ion generator of claim 31 wherein said second electrode is elongated and fin-shaped and has a base, and said third means has a pointed shape and is located at the base of the second



electrode.

91. The ion generator of claim 31 wherein said first and second electrodes are elongated and said third means is substantially shorter than the first and the second electrodes.

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92. The ion generator of claim 31 wherein said second electrode is elongated and said third means is triangle shaped.

93. The ion generator of claim 58 wherein said second electrode is elongated and has a base, and said trailing electrode is located at the base of the elongated second electrode.

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94. The ion generator of claim 58 wherein said second electrode is elongated and said trailing electrode has a pointed shape.

95. The ion generator of claim 58 wherein said second electrode is elongated and fin shaped and has a base, and said trailing electrode has a pointed shape and is located at the base of the second electrode.

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96. The ion generator of claim 58 wherein said first and second electrodes are elongated and said trailing electrode is substantially shorter than the first and the second electrodes.

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97. The ion generator of claim 58 wherein said second electrode is elongated and said trailing electrode is triangle shaped.

98. The ion generator of claim 58 wherein said second electrode is elongated and has a base and said trailing electrode is triangle shaped and located at the base of the second electrode.

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99. The ion generator of claim 1 wherein said trailing electrode is formed with the second electrode.

100. The ion generator of claim 1 wherein said trailing electrode is hollow and is formed with  
5 the second electrode.

101. The ion generator of claim 1 wherein said trailing electrode is hollow and continues from the second electrode.

102. The ion generator of claim 1 wherein said trailing electrode is formed with the second electrode and is hollow and continues from the second electrode.